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RADER FISHMAN & GRAUER PLLC LION BUILDING 1233 20TH STREET N.W., SUITE 501 WASHINGTON, DC 20036			RUGGLES, JOHN S	
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			1756	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/963,527

Applicant(s)

OGATA ET AL.

Examiner

John Ruggles

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 09 February 2004 and 08 January 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 16-23 and 26-30 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 16-23 and 26-30 is/are rejected.
- 7) ☒ Claim(s) 16-23 and 26-30 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action mailed on 8 October 2003 has now been withdrawn pursuant to 37 CFR 1.114. Applicant's submissions filed on 8 January 2004 and 9 February 2004 have been entered. In these submissions, claims 1-15 and 24-25 have been canceled, claims 16-23, 26, and 28 have been currently amended, and new claim 30 has been added. Therefore, only claims 16-23 and 26-30, received as amended on 9 February 2004, remain under consideration.

Specification

The submission on 8 January 2004 of a second substitute specification to correct additional numerous errors in the previous substitute specification filed on 25 August 2003 is hereby acknowledged. However, this second substitute specification is still replete with terms that are not clear, concise, and exact. The specification should again be revised carefully in order to comply with 35 U.S.C. 112, first paragraph. Examples of some remaining unclear, inexact or verbose terms found in the marked up version of this second substitute specification are: (1) in lines 6-9 on page 1, "the resist pattern" should be corrected to --a resist pattern--, "the substrate" should be --a substrate--, "semiconductor wafers" should be --a semiconductor wafer--, "LCD substrates" should be --an LCD substrate--, "glass substrates for liquid crystal displays"

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should be --a glass substrate for a liquid crystal display--, and “with developing the substrates” should be --and developing the substrate--; (2) in line 18 on page 1, “of which” should be corrected to --in which--; and (3) in line 27 on page 6 to line 1 on page 7, “the present invention a resist pattern forming method comprises the steps of” should be changed to --the present invention, a resist pattern forming method comprises the steps of: --, in order to be grammatically correct. Note that due to the number of errors, those listed here are merely examples of the changes required in the substitute specification and do not represent an exhaustive list thereof.

Appropriate correction is required. An amendment filed making all appropriate corrections must be accompanied by a statement that the amendment contains no new matter and also by a brief description specifically pointing out which portion of the original specification provides support for each of these corrections.

Applicants’ rewriting of the abstract in terms of the remaining method while also shortening the abstract to less than 150 words is appreciated. However, the amended abstract still needs the following minor grammatical corrections: (1) in lines 4-5, “a base film” should be changed to --the base film--, if referring to the same “base film” as recited in line 3, “a resist film” should be changed to --the resist film--, if referring to the same “resist film” as recited in line 2, and “the development” should be corrected to --a development--; (2) in line 6, “The parameter” should be corrected to --A parameter--; (3) in line 7, “the corresponding data of each of the measurement item such as” should be simplified and corrected to --corresponding data of each measurement item, such as--; and (4) in line 9, “parameters” should be corrected to --

parameter-- and “the appropriate” should be changed to --an appropriate--. Correction is again required in accordance with MPEP § 608.01(b).

Claim Objections

Currently amended versions of the claims have overcome most of the previous objections to the pending claims. The remaining objections are restated below along with new objections necessitated by amendment.

Claims 16-23 and 26-30 are objected to because of the following informalities: (1) (i) in line 3 of claim 16 and also in line 3 of claim 30, “horizontally at with” should now simply be --horizontally with--, (ii) in line 5 of claim 18, “at least for one of” should now simply be --at least one of--, and (iii) in line 2 of claim 21, “set value of corresponding” should now simply be --set value corresponding--, all because these previously marked changes had already been entered as filed previously, most of them on 25 August 2003 (but these markings have erroneously been carried through in the subsequent version(s) filed on 8 January 2004 and 9 February 2004); (2) in line 12 of claims 16 and 30 (step (d) in both claims), “at least one of measurement items” should be corrected to --at least one measurement item--; (3) in line 16 of claims 16 and 30 (step (e) in both claims), “a measured data” should be corrected to --measured data--; (4) in lines 14-15, 19, 25, 26, and 29 of claim 16, in line 7 of claim 17, in line 7 of claim 18, in line 10 of claim 19, in line 4 of claim 20, in line 7 of claim 21, in line 12 of claim 22, in line 7 of claim 23, in lines 6 and 14 of claim 28, and in lines 14-15 and 19 of claim 30, “development” should be changed to --developing--, in all occurrences, in order to be consistent with step (c) of claims 16 or 30 as the

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antecedent basis for the --developing--; (5) in line 23 of claim 16, "unit amount being a degree" should be corrected to --unit amount for a degree--, if this properly represents Applicants' original intention; (6) in line 35 of claim 16, "P respectively, the" should be corrected to --P, respectively, the--; (7) in line 2 of claim 21, "to measured item" should be corrected to --to the measured item--; (8) in line 6 of claim 22, "time period then" should be corrected to --time period, then--; and (9) in line 3 of claim 26, "the measured item" should be corrected to --the measurement item--. Claims 17-23 and 26-29 are dependent on claim 16. Appropriate correction is required.

Claim Rejections - 35 USC § 112

Currently amended versions of the claims have overcome most of the previous rejections under the second paragraph of 35 U.S.C. 112. The remaining rejections under the second paragraph of 35 U.S.C. 112 are restated below along with new rejections necessitated by amendments to the claims.

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 16-23 and 26-30 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claims contain subject matter, which was not described in the specification in such a way as to reasonably convey to one skilled in the

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relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

In step (a) of claims 16 and 30 for forming a resist film, the phrase “forming a resist film on a surface with a base film *and* a base pattern *being formed* thereon” (emphasis added) is not clearly enabled by the original specification filed on 27 September 2001. Page 10 lines 5-10 of this original specification state, in part, “...forming a resist film on a surface of a substrate...while holding the substrate with a base film *being formed* thereon...” (emphasis added).

In step (d) of claims 16 and 30 for measuring data, the phrase “an accuracy that the base pattern matches with a resist pattern” does not find consistent and unambiguous support in the original specification filed on 27 September 2001. While page 3 lines 5-7 set forth the comparison of “an accuracy that a base pattern matches with the resist pattern” (emphasis added), page 10 lines 25-26 set forth the different comparison of “an accuracy that the base film matches with a resist pattern” (emphasis added). Further support for the comparison of a base pattern to a resist pattern “of the upper tier portion” are also found at page 23 lines 14-15 and page 27 lines 16-18, whereas further support for the different comparison of a base film with a resist pattern are also found at page 48 lines 11-13 (involving comparison of the resist film with “the pattern of the base film”), page 52 lines 1-2, and page 64 lines 11-12. On page 11 in the amendment filed 8 January 2004 and again on page 8 of the amendment filed on 9 February 2004, Applicants assert that in the specification the “base film” means “a film for etching (a metal film, for example)” and the “base pattern” means “a pattern that has been etched in a previous step of an underneath layer”. Applicants further assert that the “base film” was formed on top of the “base pattern” as an underlying layer. However, these assertions of definitions and

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relative position of the “base film” and the “base pattern” would NOT have been clear to one of ordinary skill in the art solely from the text of the original specification filed on 27 September 2001. Therefore, these clarifications would constitute new matter, and so they cannot be added to the specification; that is, unless Applicants can point to specific support for these assertions in the original specification. Claims 17-23 and 26-29 are dependent on claim 16.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter, which the applicant regards as his invention.

Claims 16-23 and 26-30 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In step (a) of claims 16 and 30 for forming a resist film, it is unclear whether “a base film and a base pattern being formed” (emphasis added) found in lines 2-3 of both these claims refers to (1) the resist film formed in this step or (2) an underlying base film and a base pattern already on the substrate now being coated by the resist. Lines 6-7 on page 20 of the instant second substitute specification filed 8 January 2004 state, in part, “...measurement data of the reflection ratio of the base film measured before resist coating” (emphasis added). This suggests the latter interpretation (2). However, claims 16 and 30 must still be amended in response to this rejection.

Furthermore, in step (d) of claims 16 and 30, the phrase “an accuracy that the base pattern matches with a resist pattern” is also unclear since it is not apparent how such a comparison could be made or would even be useful unless (i) the base pattern had been formed by transfer of

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the pattern in the overlying resist (e.g., by etching through the resist pattern, etc.) **and** (ii) any intervening layer(s), such as the base film, had also already been patterned (e.g., by etching through the resist pattern, etc.), but such patterning or etching of the base pattern and the base film ***through the overlying resist pattern*** has not yet been claimed. Although rewritten from prior versions, this comparison in claims 16 and 30 still lacks antecedent basis and does not even appear to be adequately supported in the original specification filed on 27 September 2001 to enable one of ordinary skill in the art to understand and employ such a comparison of accuracy for the base pattern relative to the overlying resist pattern. Claims 17-23 and 26-29 are dependent on claim 16.

Claim 22 at line 6 lacks antecedent basis for "the etched line". The examiner suggests changing the phrase "a line width of the etched line" recited in line 6 to the simpler phrase --an etched line width--, in order to overcome this rejection and provide better antecedent basis for the subsequently recited phrase "the etched line width" (found at least in line 7 of claim 22, line 2 of claim 23, and line 2 of claim 28). Claims 23 and 28-29 are dependent on claim 22.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claim 30 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nakayama, et al. (US Patent 5,747,201) in view of Batchelder, et al. (US Patent 4,647,172), further in view of

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Auda, et al. (US Patent 5,139,904), further in view of Phan, et al. (US Patent 5,985,497), further in view of Lewis, et al. (US Patent 5,308,447), further in view of Sanada (US Patent 5,843,527), further in view of Yoon, et al. (US Patent 5,283,141), and further in view of Bae (US Patent 5,766,809).

Nakayama teaches a process for controlled forming and treating of a thin film (coating a photoresist or resist using a spinner (spin coating) at column 8, line 22 and column 12, line 17) on a wafer or substrate with or without an undercoating (column 9, line 41, base film and/or base pattern). This spin coating is understood to encompass supplying a resist solution through a nozzle onto a substrate held by a horizontally rotating holder to spread the resist solution by centrifugal force over the substrate (instant claim 30 step (a)). An optical property measuring system (instant claim 30 step (d) for measuring data) is used to control (instant claim 30 step (e) for amending a set value based on measured data) the rotating frequency (instant claim 30 step (e) for amending rotating speed) of the spinner during spin coating of the resist, temperature in a baking furnace, or resist baking time (column 12, lines 12-24). The optical measuring system detects reflectivity of the undercoat (instant claim 30 step (d) for measuring the reflection ratio of the base film), resist film thickness (instant claim 30 step (d) for measuring resist film thickness), and reflectivity of the resist which are input into an optimum exposure detecting system to determine the resist index of refraction and obtain an optimum exposure energy composed of the irradiation illuminance (intensity of the ray radiated from the exposing portion to the substrate, instant claim 30 step (e) for amending exposure intensity) and the exposure time (instant claim 30 step (e) for amending a time period for the exposure) at column 9, lines 36-55. The thickness of resist obtained is used to calculate the variation with time of the resist index of refraction to

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adjust or amend the exposure properties (exposure intensity and time). A television camera is connected to an X-Y stage for alignment of a resist-coated wafer (instant claim 30 step (e) for amending alignment of the exposing portion and the substrate) in an exposure apparatus controlled by measured optical properties (column 9, line 56 to column 11, line 13). The control of exposure through a patterned reticle or mask is described at column 13, lines 7-67. This exposure process is understood to encompass disposing the resist coated substrate at the focus point of a lens in an exposing portion having a light source and the lens by radiating a ray of a controlled or predetermined intensity for a controlled or predetermined time period, using a predetermined pattern mask (instant claim 30 steps (b) and (e) for amending the exposure intensity and time period for the exposure). Developing of the exposed resist is controlled by optical property measurements for the resist (column 8, line 54 to column 9, line 3). The developing is understood to encompass supplying a developing solution of a predetermined temperature onto the exposed resist and leaving the supplied developing solution on the resist for a predetermined time period (instant claim 30 steps (c) and (e) for amending a time period for the developing and a temperature of the developing solution when developing the resist on the substrate). Nakayama also suggests controlling subsequent etching using optical properties measured before, during, or after film formation in the abstract, Figure 4, and specifically states this intention in claim 3 (column 15, lines 59-62). Controlling subsequent etching is understood to encompass etching the substrate by supplying an etching gas of a predetermined composition ratio to the substrate for a predetermined time period.

While teaching a photolithographic process involving control or amendment of many of the same parameters in accordance with some of the same type of measured data as are recited in

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the instant claim, Nakayama does not teach all the claimed alternatives and recited limitations in these instant claims. In particular, Nakayama does not specifically teach measuring at least one of the following: base film thickness, line width after developing, accuracy of a base film pattern as compared to the resist pattern, and surface defects. Nakayama also does not specify using each of these measurements in accordance with the relative degree to which each contributes to an amended parameter for amending at least one of the following: degree of acceleration and/or nozzle position during spin coating, and distance between the focus point and the substrate during exposure.

Batchelder shows an automatic process for coating a resist on a semiconductor wafer, patterned exposure of the resist, spin developing of the exposed resist pattern, and etching through the developed resist pattern (column 1, line 66 to column 2, line 37). Control or amendment of the developing time is calculated based on a predictable scaling factor "A" at column 4, lines 22-28. The scaling factor "A" is determined based on microscopic observation (optical measurement) of line widths after developing as shown in Figure 1 and described at column 6, lines 3-15. The use of scaling factor "A" is understood to be equivalent to determining the contribution degree of developing time (controlled by amendment) to obtain a desired line width after developing (measured). This process of using variable controlled or amended developing time results in improved consistency of measured line widths over that using a fixed development time. Similar improvements were also observed with respect to variations in resist coating thickness (measured) and resist baking or heating time (controlled or amended, column 6, lines 42-55 instant claim 30 steps (d) and (e) for measuring resist film thickness or resist line width after developing in order to control amendment of resist heating

time or resist developing time, respectively). The fact that similar improvements were observed for controlled amendment of each parameter (e.g., resist heating time, resist developing time, etc.) using different degrees of contribution derived from predetermined scaling factors for each measured variable (e.g., resist coating thickness, resist line width after developing, etc.) suggests that relative degrees of contribution for each measured variable would be expected to result in even better control of each parameter for optimization of a photolithographic process having similar steps.

Auda describes a method of producing high resolution and reproducible patterns (typically polysilicon ultra-fine lines, in the abstract). A polysilicon layer (base film) on an insulating substrate is coated with a standard photoresist or resist by conventional techniques as explained in respect to Figure 1A, which is described to include spin coating of the resist (column 2, lines 12-33 and column 5, lines 35-40). The resist is imaged with UV radiation through an appropriate or predetermined mask, post-exposure baked or heated, and developed to produce the resulting structure shown in Figure 2B and described at column 5, lines 40-45. This is followed by either (1) first isotropic etching by high pressure RIE of the resist pattern 17a to simultaneously reduce the resist thickness and line width to 17a' as shown in Figure 2C, then anisotropic or directional etching by low pressure RIE of the polysilicon layer (base film) using the reduced resist image and removal of the remaining resist as shown in Figure 2D (column 5, line 50 to column 6, line 13) or (2) first anisotropic or directional RIE of the polysilicon (base film) using the original (unreduced) resist image as shown in Figure 3B and removal of the remaining resist to form the polysilicon (base film) pattern 16b as shown in Figure 3C, then isotropic RIE of the polysilicon (base film) pattern to simultaneously reduce the base film pattern

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thickness and line width to form 16b' as shown in Figure 3D (column 6, lines 18-42). The isotropic etching of the resist pattern is optically measured to control or amend this etching process to obtain the desired resist film thickness and line width (column 6, lines 1-7). It is also paramount that base film etched line width and thickness be accurately monitored (optically measured) during etching to control or amend etching conditions (etching time for a specified gas composition) at column 6, lines 38-41 and column 7, lines 4-11 (instant claim 30, step (d) for measuring base film thickness).

Phan discloses a method for reducing defects in a semiconductor lithographic process by measuring defects using a scanning electron microscope (SEM) to review and classify the defects into different types and causes (abstract and column 3, lines 26-30). A pattern is formed on a first silicon wafer using a prescribed lithography fabrication processing specification, inspecting or measuring the pattern for defects, developing an alternative or amended processing specification to correct for measured defects, using the amended process to form a pattern on a second silicon wafer, then comparing the first and second patterns, and changing or amending the lithographic process based on the comparison (resulting from defect measurement, column 2, lines 30-44). The comparison of defect measurements (to determine if the amended process improves yield with a comparable parameter quality) includes those in critical dimensions (CD, understood to encompass base film thickness and etched line width), resist profile (resist film thickness and line width after developing), etch bias (understood to be indicative of the accuracy of an etched base film pattern as compared to a corresponding resist pattern used as an etching mask), and electrical properties is disclosed at column 5, line 63 to column 6, line 5 (instant claim 30 step (d) for measuring base film thickness, resist film thickness, line width after

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developing, accuracy of a base film pattern as compared to a resist pattern, and surface defects; instant claim 30 step (e) for amending developing time; instant claim 30 for measuring base film thickness and amending developing time; instant claim 30 for measuring resist film thickness and amending developing time; instant claim 30 for measuring line width after developing and amending developing time; instant claim 30 for measuring defects and amending developing time; and instant claim 30 for amending developing time based on etched line width). This comparison and subsequent amendment optimizes the lithography process by reducing defects (column 2, lines 8-9). For optimization by amending properties based on measured defects, Phan discusses changing or amending developing conditions (specifically, developing time) at column 7, line 46 to column 9, line 3.

Lewis teaches a process of controlled or amended positioning of developer nozzles 21 and 23 at different distances from the center of rotation over a spinning resist coated article or wafer substrate based on optical measurements (by photodetectors to measure completion of developing that could involve measurement of line width after developing) during the process as shown in Figure 1 and described at column 3, line 45 to column 4, line 55. This is understood to be equivalent to amendment of a nozzle position for resist spin coating based on an optical measurement (e.g., resist film thickness, etc.; instant claim 30 step (d) for measuring resist film thickness; instant claim 30 step (e) for amending nozzle position during spin dispensing or coating; and instant claim 30 for amending nozzle position during spin dispensing or coating). Etching can also be accomplished by a liquid etchant applied to a spinning substrate in much the same controlled manner (by amendment based on a measurement) as spin coating a resist on a substrate or developer on an exposed resist (column 7, lines 55-57). Plasma dry etching can be

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conducted using optical measuring of etching progress (e.g., by measuring etched line width, etc.) to control or amend the etching process (e.g., to change gaseous etchant composition ratio, control etching time, etc.) as shown in Figure 5 and described at column 7, line 57 to column 8, line 21. Temperature of the developer (solution) or, alternatively, an etchant supplied through nozzles 21 and 23 is also controllable (Figures 1-2, column 8, lines 58-62; instant claim 30, step (c) for supplying a developer solution at a predetermined temperature; instant claim 30, step (e) for amending developer solution temperature when developing). The rotation speed and linear motion of the substrate can be controlled along with a process variation for rotating distribution nozzles to selectively treat only portions of the rotating substrate (column 9, lines 3-12; instant claim 30 for amending rotation speed of the substrate during resist spin coating). Both the flow rate and direction of individual nozzles can be controlled (column 9, lines 19-21; instant claim 30 step (e) for amending nozzle position during resist spin coating). Developer (solution) or etchant composition can be controlled by selective mixing of plural components in response (amended by) system controllers 55 or 103 as shown in Figures 1 or 2 and described at column 9, lines 21-24. Uniformity is obtained by controlled correction or amendment for variations (measured) across the surface of a substrate during processing (column 1, lines 9-13 and column 2, lines 18-24).

Sanada discloses a method of spin coating photoresist or resist on a horizontal substrate (semiconductor wafer, column 1, lines 7-11, column 18, lines 50-52, as shown in Figure 4). Back rinse nozzles 11 remove extraneous resist from the backside or underside of the substrate and a resist supply nozzle 5 delivers resist to the substrate during coating. Acceleration or increasing rotation speed applied after beginning centrifugal spreading leads to the curved

coating patterns shown in Figures 6C-D, due to inertia of the resist during increasing rotation of the substrate as described at column 20, lines 25-56 (instant claim 30 step (e) for amending rotating substrate degree of acceleration and nozzle position during resist spin coating; instant claim 30 for amending rotating substrate degree of acceleration during resist spin coating). As a result, a desired resist film thickness is formed on the substrate wafer by using a drastically reduced supply of resist solution (column 21, lines 24-26). This reduces cost (because less resist is wasted) and improves throughput for manufacture of semiconductor elements and devices (column 23, lines 43-53). Column 25, lines 48-58 also disclose use of a movable resist dispensing nozzle, adjustable or amendable based on resist viscosity, wafer size, and surface condition.

Yoon shows a photolithography method and corresponding apparatus controlled or amended by measuring optical characteristics of the resulting latent image. Adjustment or amendment means such as a computer 104 adjusts or amends control parameters according to information obtained from observations or measurements of latent images by a phase contrast microscope 110 as shown in Figure 1 and described at column 3, lines 8-11. The latent image (characterized by image line width at column 3, lines 58-59) is discernable as changed "optical thickness" in the resist due to changed refractive index in the exposed pattern portions, depending on the length or time and intensity of exposure (column 3, lines 28-53). The image measurement is alternatively described as occurring while exposure of the resist is actually taking place to provide in-situ monitoring/observation for correction or amendment of the exposure process (column 4, lines 15-19). As shown in Figure 3 and described at column 4, lines 49-54, the image measurement controls adjustment or amendment of exposure conditions

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including numerical aperture, exposure time, wafer position, focus (which encompasses distance between the focus point of the exposing portion and the substrate during exposure), and illumination coherence (instant claim 30 step (e) for amending exposure intensity and time, and distance between the focus point and the substrate during exposure; instant claim 30 for amending exposure intensity or distance between the focus point and the substrate during exposure; instant claim 30 for amending exposure intensity or distance between the focus point and the substrate based on measured line width (to reveal defects); and instant claim 30 for amending exposure intensity, exposure time, or distance between the focus point and the substrate during exposure based on measured line width (understood to be indicative of line width after etching)). Column 6, lines 52-55 state that the in-situ latent image measurement allows quick adjustment or amendment of the exposure stepper apparatus for each new mask layer or batch of wafers, without having to develop the exposed resist (which shows that measuring the latent image line width is an appropriate substitution for measuring the line width after developing, instant claim 30 step (d) for measuring line width after developing).

Bae describes a method for testing an overlay in a semiconductor device for alignment (of a substrate exposing portion). An etch layer (base film) is coated on a semiconductor wafer, then etched through a photoresist or resist film pattern to form outer alignment marks 42 shown in Figures 9-10 and described at column 5, lines 50-60. The first resist is removed and another resist layer 45 is coated over the marks 42, exposed through a patterned mask (which is aligned with the etched marks 42 on the substrate), and developed to form an inner mark including an island portion 43 inwardly spaced from the outer marks 42 by a desired width and a land portion 44 to form an overlay measuring mark shown in Figure 10 and described at column 6, line 61 to

column 7, line 5. The overlay is then used for an accurate alignment measurement (column 7, lines 6-10) (instant claim 30 for measuring accuracy of the base film pattern as compared to the resist pattern and amending alignment of the exposing portion with the substrate).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the controlled or amended photolithographic process based on measured data taught by Nakayama with controlled or amended resist heating time or resist developing time to obtain improved consistency of resist coating thickness or resist line width after developing, respectively, and that using relative degrees of contribution for each measured variable would be expected to result in even better control of each parameter for optimization of a photolithographic process having similar steps as suggested by Batchelder; and/or with controlled or amended etching conditions based on relative degrees of contribution for measured base film thickness or accuracy of etched line width (as compared to the resist pattern) to produce high resolution and reproducible patterns as described by Auda with incorporation of the relative degrees of contribution concept for each variable as suggested by Batchelder.

Anisotropic or directional etching of the base film using the resist image or pattern along with line width measurements of the resist pattern and the corresponding etched base film or base pattern as described by Auda would also be expected to provide parameters for resulting control or amendment of the etching process along with incorporation of the relative degrees of contribution concept for each variable as suggested by Batchelder (instant claim 30 step (d) for measuring accuracy of an etched base film pattern as compared to the resist pattern to amend a process parameter). It would also have been obvious to combine the controlled or amended photolithographic process based on measured data taught by Nakayama, Batchelder, and/or Auda

as discussed above with defect correction and reduction (by an amendment based on defect measurement) for optimizing the photolithography process as disclosed by Phan.

Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the controlled or amended photolithographic process based on measured data taught by Nakayama, Batchelder, Auda, and/or Phan with controlled or amended dispensing nozzle position (for resist spin coating or developing solution spreading), developer solution temperature, or line width after developing based on measured resist film thickness for resulting uniformity even when surface variations occur during processing as taught by Lewis; and/or with controlled or amended degree of acceleration during resist spin coating based on measured resist film thickness to achieve reduced cost and improved throughput as disclosed by Sanada. It would also have been obvious to combine the controlled or amended photolithographic process based on measured data taught by Nakayama, Batchelder, Auda, Phan, Lewis, and/or Sanada with controlled or amended distance between the focus point and the substrate during exposure, exposure intensity, or exposure time based on measured line width (latent image line width substitutes for line width after developing) to allow quick in-situ amendment of exposure conditions; even before developing as shown by Yoon and/or amending alignment of the exposing portion of the substrate based on measured accuracy of the base film pattern as compared to the resist pattern for accurate alignment as described by Bae. All of these photolithographic process combinations would also be expected to benefit from incorporation of the relative degrees of contribution concept for each variable as suggested by Batchelder. As a further extension of this approach, one of ordinary skill in the art at the time the invention was made would logically have given priority to amendment of each parameter having a greater

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effect or higher degree of contribution on the resulting measured outcome or variable in order to more rapidly approximate optimized process conditions (e.g., by making largest amendments first, then lesser amendments, all the way down to the amendment having the lowest relative degree of contribution in the corresponding measured variable, etc., instant claim 30). It is also known to clean extraneous or defective portions of resist from the substrate by rinsing or dissolution as disclosed by Sanada and could be combined with subsequent replacement of this previous resist determined to be defective by another layer of resist for patterning without defect as disclosed by Bae. This is because these references relate to the same art of semiconductor manufacturing involving resist processing.

Allowable Subject Matter

Claims 17-23 and 26-29 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims; **and** further revised to also remove all remaining other objections and formal rejections (under 35 U.S.C. 112, first and second paragraphs) set forth in this Office action, while including all of the limitations of the base claim and any intervening claims. Similarly, independent claim 16 would also be allowable if fully revised to remove all remaining objections and formal rejections (under 35 U.S.C. 112, first and second paragraphs) set forth in this Office action.

The following is a statement of reasons for the indication of allowable subject matter: while a resist film thickness formed by spin coating is known to depend on the temperature of resist liquid supplied to a substrate (T_r), the ambient temperature (T_c), the humidity (H_c), and/or

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the pressure (P) in a coating unit during spin coating as discussed above, the more specific relationship described by the formula:

$$R_t = \alpha (\mu_1 Tr + \mu_2 Tc + \mu_3 Hc + \mu_4 P)$$

where α is a constant and μ_1 , μ_2 , μ_3 , and μ_4 are coefficients describing the degree of contribution for each of Tr, Tc, Hc, and P, respectively, is distinguished over the prior art, which does not teach this specific formula for the resist film thickness, R_t , formed during spin coating.

As allowable subject matter has been indicated, applicant's reply must either comply with all formal requirements or specifically traverse each requirement not complied with. See 37 CFR 1.111(b) and MPEP § 707.07(a).

Response to Arguments

Applicants' arguments with respect to claims 16-23 and 26-30 as currently amended on 9 February 2004 have been considered but are either moot or not deemed persuasive in view of the maintained and new ground(s) of objection and rejection set forth above.

Applicants' allege in their remarks on page 8 of their amendment filed on 9 February 2004 that the Examiner had previously ignored their arguments on page 11 of the previous amendment filed on 8 January 2004 with regard to the intended meanings for "base film" and "base pattern". However, the Office action mailed 5 February 2004 specifically addressed these remarks on page 11 of the amendment filed 8 January 2004 and further explained the reason why they were not found persuasive (namely that "it was still unclear how an accuracy of the 'base pattern' could be matched or compared to that of the overlying resist..."). Therefore, Applicants' remarks were NOT ignored, but instead these remarks were just not found persuasive. The

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formal rejections set forth above again answer Applicants' arguments in reference to current amendments to the instant claims regarding use of the phrases "base film" and "base pattern", while more fully explaining the Examiner's position on this issue.

Applicants have further stated in their remarks on page 9 of their amendment filed on 9 February 2004 that "how an accuracy of the "base pattern" could be matched...", that is, the method for measuring the accuracy of the base pattern, is not an element recited in the pending apparatus claims". It is not clear what is meant by this statement because: (1) step (d) at line 14 of instant claim 16 clearly recites "an accuracy that the base pattern matches with a resist pattern", which is clearly understood as a measurement item for measuring the accuracy of the base pattern and (2) there are no longer any pending apparatus claims (previous apparatus claims 1-15 have been canceled). Applicants are therefore requested to clarify the record by explaining what was actually meant by this statement.

While applicants have corrected many of the previous errors in the original specification and also some of those in the first substitute specification filed on 25 August 2003 by submission of a second corrected substitute specification filed on 8 January 2004, numerous errors still remain. These remaining errors are again represented by a very limited set of examples listed above, because of the large number errors needing correction. The specification should again be more carefully and fully revised in order to comply with 35 U.S.C. 112, first paragraph.

The amended abstract also needs further revision to correct various minor grammatical errors pointed out above.

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The currently amended versions of the claims have overcome most of the previous objections, but have also necessitated further new objections. Remaining objections not yet overcome have been set forth above.

Currently amended versions of the claims have overcome the previous rejection under the first paragraph of 35 U.S.C. 112 and most of the previous rejections to the pending claims under the second paragraph of 35 U.S.C. 112. The remaining rejections under the second paragraph of 35 U.S.C. 112 are restated above along with new rejections under both the first and second paragraphs of 35 U.S.C. 112, which are necessitated by amendments to the claims.

Allowable subject matter that was previously identified in claim 24 (now canceled) is now found in claims 16-23 and 26-29, but all of these claims are again rejected due to both residual and new formal matters (objections and rejections) necessitated by amendment for at least the reasons set forth above.

Newly added claim 30 has been found to be obvious over the previously cited prior art of record for at least the reasons discussed above.

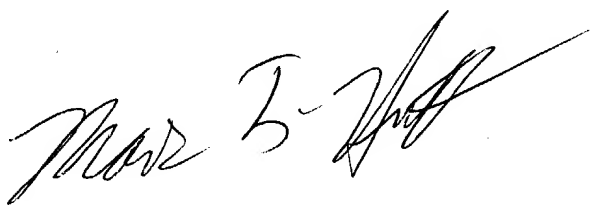
Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to John Ruggles whose telephone number is 571-272-1390. The examiner can normally be reached on Monday-Thursday and alternate Fridays.

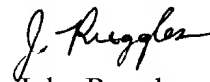
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Examiner
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